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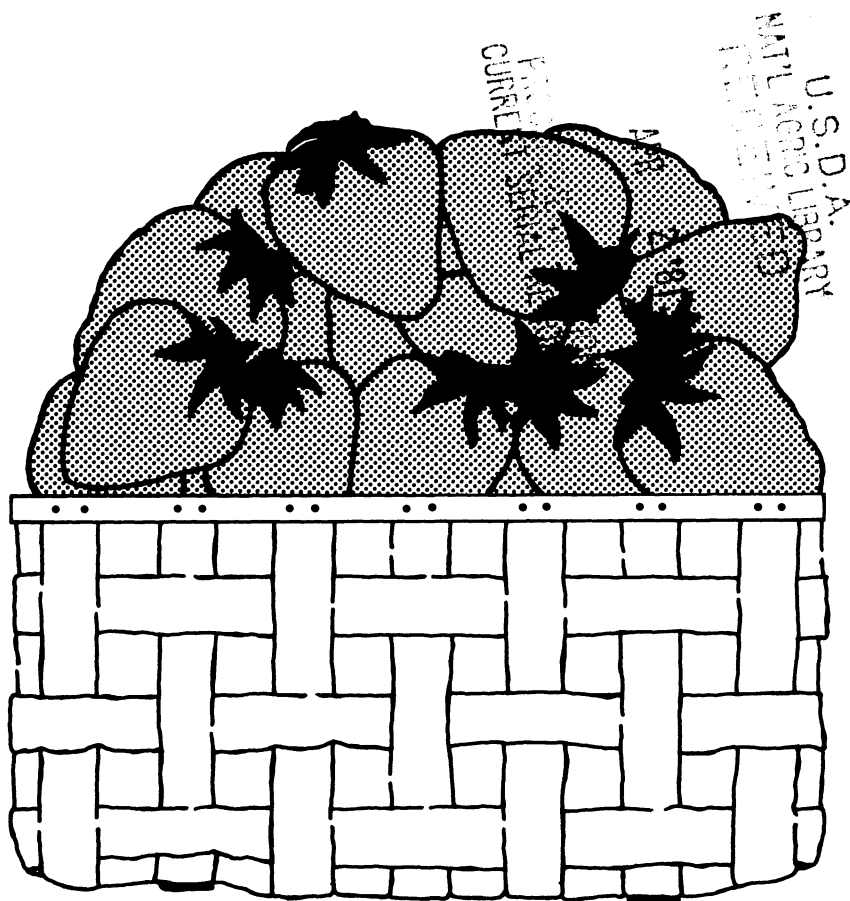
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Strawberry Culture:

Eastern United States .



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AGRICULTURE

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Strawberry

Culture:

Eastern United States

Strawberries are an important crop in the eastern United States. This bulletin recommends growing methods for that part of the East bounded by the Great Plains on the west and by the Coastal Plain on the south (fig. 1).



Figure 1.—The regions to which this bulletin applies are indicated by shading.

Strawberries produce well in most of the region, but favorable growing conditions do not ensure success; economic conditions must also be favorable. Before you decide to grow strawberries on a commercial basis, consider these factors:

- **Labor.** Is it possible to obtain workers when they are needed?
- **Market.** Is there a dependable market outlet?
- **Planting Stock.** Are plants available for the varieties you want to grow?

How the Plants Grow

Healthy dormant plants set in moist soil in early spring produce new roots in a few days. In a few more days, each plant usually has several new leaves of normal size.

Beginning in June, and continuing into early fall, runners emerge where the leaves join the main stems. These runners grow outward, form new plants, and take root several inches from the original plant (fig. 2). New runners grow from the new plants, and in this way a succession of independent new plants are soon growing around the original plant.

Plants produce flowers the first year, and the flowers will develop into fruit if they are not pinched off. Usually, the flowers are pinched off so that the plant itself will develop, grow vigorously, and be capable of producing a good fruit crop the next spring.

In the fall, the growing points in the crown change into flower buds. This happens about September 1 in early varieties, and from about September 20 to about October 10 in late varieties. The buds grow rapidly, and by the end of October they can readily be seen by opening the crowns. In vigorous plants, buds also develop in many of the leaf axils.

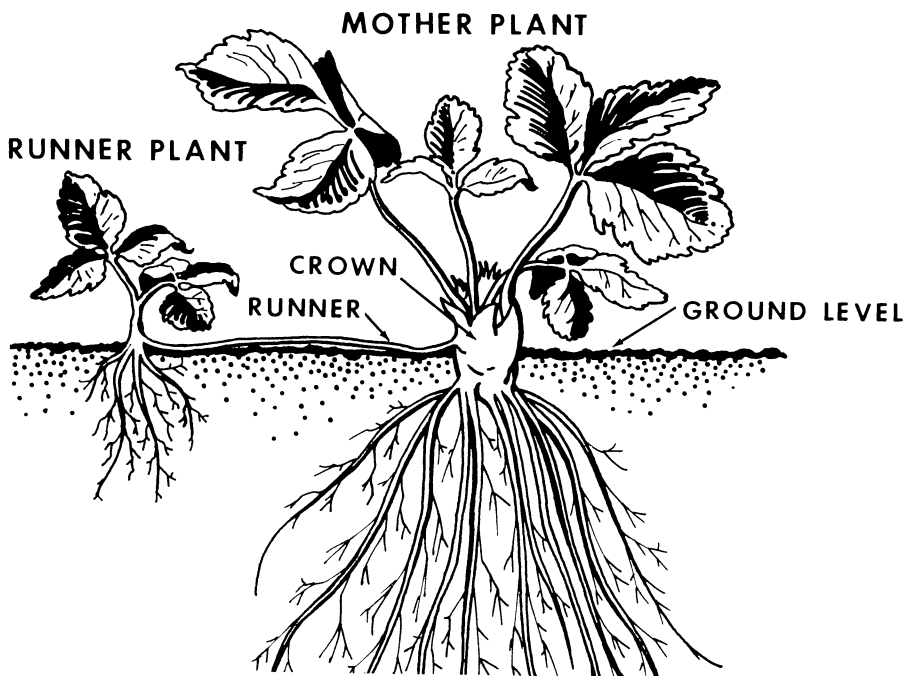


Figure 2.—Strawberry plants produce runners, which take root and form new plants.

The number of leaves on a plant in the fall is an indication of the following year's production: usually the more leaves, the more berries the plant will produce the next spring.

Plants become dormant after the days become short and cool. All the older green leaves die, and so do the connecting runners.

In the spring of the fruiting year the flower buds renew growth and develop into flowers. The first flower to open on a cluster contains the most pistils (female elements), is the largest, and becomes the largest fruit with the most seeds. The next flower to open becomes the next largest fruit, and later flowers become successively smaller fruits.

In mild weather, strawberries mature about 30 days after bloom-

ing. In warm weather, they mature more rapidly.

Suitable Sites Location

In selecting a site for a strawberry planting, consider air and water drainage, land slope, and direction of land exposure.

If late spring frosts are frequent in your locality, choose a site on ground slightly higher than the surrounding areas. There is less danger of frost damage on the high ground, because cold air drains to the adjoining low ground.

Ordinarily, a site that slopes gradually is preferable to one that slopes steeply, since a gradual slope is less liable to soil runoff.

Select a site that slopes toward the south if you want the crop to ripen as early as possible; select one that slopes to the north if you want to delay ripening. Strawberries on southern slopes ripen several days sooner than those on northern slopes.

Soil Requirements

Strawberries may be grown successfully on almost any type of soil that contains a good supply of organic matter. Growers wishing to produce early fruit usually prefer sandy soil.

Strawberries thrive in well-drained soil that is moist but not wet. Plants are liable to be killed when wet ground freezes in the winter, especially if the soil is clay or fine sandy silt. Wet soil inhibits plant growth and may lead to damage by red-stele root rot.

Training Systems

Three training systems are commonly used:

- Hill system—no runners are allowed to grow.
- Spaced matted-row system—some runners are allowed to grow.
- Matted-row system—most runners are allowed to grow.

The hill system and the spaced matted-row system are recommended for use with irrigation and in intensive cultivation. The hill system is not recommended where there is danger from white grubs, drought, or severe winters. Where these dangers exist, use the matted-row system. Hill system plantings are most often used for home gardens.

Hill System

In the hill system, plantings are made either in double or triple rows, with the plants 10 to 12 inches (25 to 30 cm) apart in the rows, and with 12 inches (30 cm) between adjoining rows. A 24-inch (61 cm) alley is left between each group of rows. Figure 3 illustrates

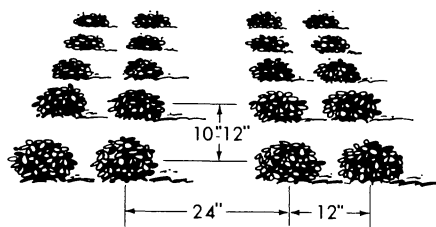


Figure 3.—In the double-row hill system, a 24-inch (61-cm) alley separates rows that are 12 inches (30 cm) apart. Plants in the rows are 10 to 12 inches (25 to 30 cm) apart.

the double-row hill system, in which 29,000 plants are set per acre (71,659 plants/ha). Figure 4 illustrates the triple-row hill system, in which 32,670 plants are set per acre. (80,727 plants/ha)

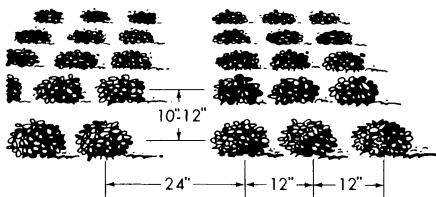


Figure 4.—Planting in the triple-row hill system is the same as for the double-row hill system (see fig. 3) with one exception: There are three rows between alleys instead of two.

Spaced Matted-Row System

In the spaced matted-row system, set the plants 18 to 24 inches (46 to 61 cm) apart in the rows. Leave a 42-inch (107 cm) space between the

rows. Planting an acre under this system requires 6,225 plants if the 24-inch (61 cm) spacing is used, or 8,300 plants if the 18-inch (46-cm) spacing is used.

Matted-Row System

Spacing for the matted-row system is the same as for the spaced matted-row system.

Because there is no runner placement, and less weed-control work, growing strawberries in matted rows costs less per acre than growing them in spaced matted rows.

Under the matted-row system, individual plants are apt to be crowded, and because of crowding, yields and individual fruit size may be smaller than under the spaced matted-row system.

Varieties

The selection of varieties to plant depends on climate, soil, and the

purpose for which the crop is to be grown.

Some special-purpose varieties bear firm berries especially suited to long-distance shipment. Others have large attractive berries of the best quality, but their texture is too soft for long-distance shipment. Still other varieties have a bright-red, firm flesh and a tart flavor; these are suitable for freezing and are also sold to dealers who supply the soda-fountain trade.

Select varieties that will ripen when the market demand is good and when competition from other localities is low (fig. 5).

If spring frosts are apt to injure crops in your area, select late-blossoming varieties and those least susceptible to frost injury.

For the home garden, grow early, medium, and late varieties to provide fruit through a long season.

If you plan to grow strawberries for the wholesale market, select

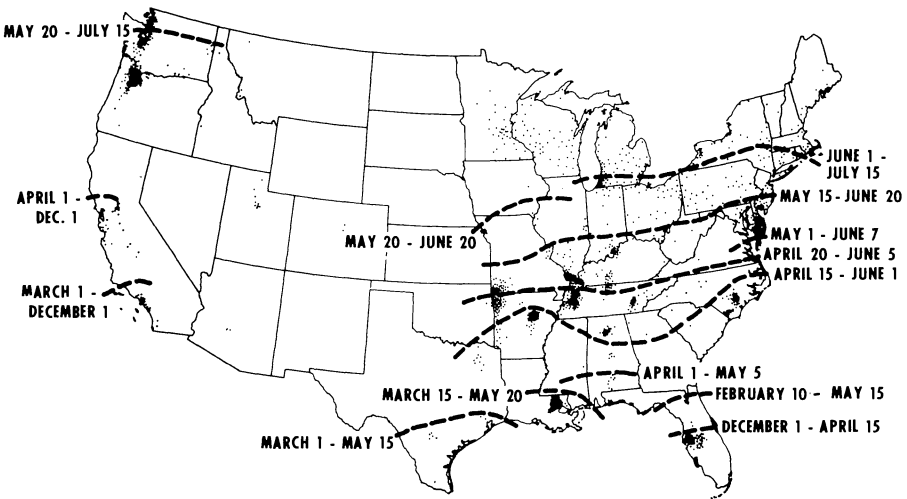


Figure 5.—Map showing the location of principal commercial strawberry-producing regions, the approximate ripening time in each region, and the northward progression of the strawberry season.

varieties that are well known; they command higher prices. Buyers prefer full truckloads or carloads of one variety or—at least—of varieties that are similar in color, shape, flavor, and shipping quality.

It may be a good plan to grow two or three varieties that have different blossoming times: if frosts occur, one variety may be much less injured than the others.

If you plan to grow the crop for a local market, select three or four varieties to supply the market in the very early, medium early, mid-season, and late ripening periods.

Be sure that these varieties are firm-fleshed, have “skin” that does not bruise easily, and will tolerate extended periods on the plant in a ripe condition until customers can harvest them.

In general, select varieties for culture that are disease-resistant, possess high fruit quality, and are adapted to your growing area.

For a more complete discussion of varieties, see Farmers’ Bulletin 1043, “Strawberry Varieties in the United States.”¹

Obtaining Planting Stock

Young plants for starting a planting are usually obtained from commercial nurseries. Make an ef-

¹ For single free copies of U.S. Department of Agriculture publications referred to in this bulletin, see your local agricultural agent or write the Office of Governmental and Public Affairs, U.S. Department of Agriculture, Washington, D.C. 20250. Include your ZIP code in your return address.

fort to get disease-free and nematode-free planting stock.

It is usually easier to get nursery-grown plants in the spring than in other seasons.

If you have an established planting, you can get planting stock from it. In very early spring, select and transplant the most vigorous of the young plants that are growing alongside the bearing rows. Choose these plants from plantings that are free from diseases and insect infestations. This practice is not recommended if the strawberries are growing on clay, because the roots are not strongly developed when grown on clay and usually break when moving is attempted.

In general, it is wiser to secure plants from a grower of certified strawberry plants than to transfer them from a previous planting, because you will be less likely to transfer accumulated disease, insect, and nematode problems to the new field.

Care of Planting Stock

There are usually only one or two young leaves on each plant when it is received from the nursery. Remove all but one small leaf.

The roots should be fresh and bright. Roots of healthy plants grown on muck soils are dark; roots of healthy plants grown on other soils are white or yellowish. Plants in good condition for setting are shown in figure 6.

If plants received from the nursery cannot be set for several days, they should be kept in cold storage or they may be heeled in.



Figure 6.—Plants in good condition for setting.

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Cold Storage

If the plants are not fully dormant when they arrive from the nursery, keep them at 40° to 42° F (4° to 5° C) for a few days or at 32° to 36° F (0° to 2° C) for a longer period. If they are received in a fully dormant state, store them at 30° to 32° F (−1° to 0° C).

Before storing the plants, wrap them in polyethylene film to prevent them from drying out.

The plants may be kept in a refrigerator if desired.

Heeling In

If the plant roots are very dry, soak them in water for several hours before heeling in. Heel them in individually in a V-shaped trench deep enough for the roots to spread out when the crowns are at ground

level. Lay the plants along one of the sloping edges of the trench. Space them so that the roots of adjacent plants will not get tangled. Pack the soil firmly about the roots, and leave the plants heeled in until they are wanted in the field. Placement of plants in a trench is diagramed in figure 7.

If the plants are extremely dry when received, let them start a new root system while they are heeled in. When you remove these plants from the trench, take extra care to avoid damaging the tender young roots.

Preparing the Soil

Strawberries grow best in well-prepared soil that is high in organic matter.

If culture of the previous crop included thorough seedbed prepa-

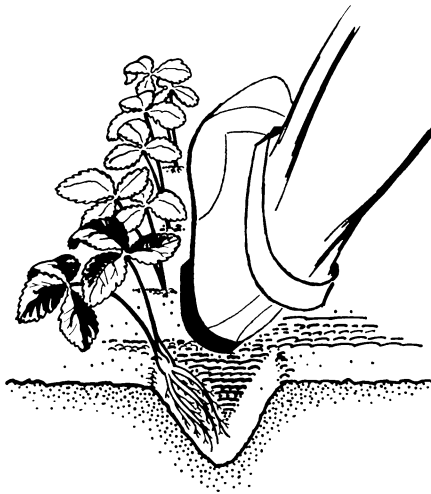
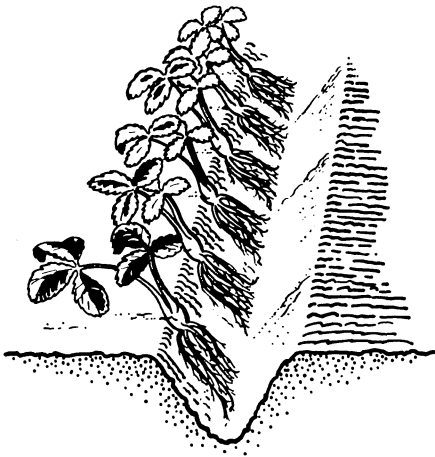


Figure 7.—To heel in plants, place them in a trench with the crown at ground level (top), and firmly pack soil about the roots (bottom).

ration, cultivation, and either turning under green manure or adding stable manure, only harrowing is needed to prepare the soil for planting.

If culture during the previous year or two has not included these practices, at least 1 year of special preparation will be needed for best results.

If the soil lacks organic matter, plant a green-manure crop, or apply

stable manure. If the soil is very deficient in organic matter, you may need to plant at least two green-manure crops before it is ready for planting strawberries. Ordinarily, one crop of crimson clover—or rye and vetch—is sufficient. Where these cannot be grown successfully, substitute cowpeas, Canada peas, buckwheat, Sudan grass, or some other commonly grown green-manure crop.

Use the cover crop best suited to your location and fertilize it heavily to obtain rank growth and an abundance of green manure.

Sufficient organic matter may be supplied during the year previous to planting strawberries by (1) applying a large quantity of stable manure on a crop such as sweetpotatoes or tobacco, and (2) following with a green-manure crop.

On sandy soils damage from strawberry root aphids and nematodes is a hazard. Damage is particularly serious in the States along the Atlantic Coast and is often serious in the central part of the region. Losses are much greater when the strawberry planting follows corn, grass, or weeds, because then the ants that carry the aphids from plant to plant are usually abundant. There are generally few ants, however, following crops of sweetpotatoes or tobacco. Either plant strawberries after one of these crops, or control the ants in accordance with recommendations of your State agricultural experiment station.

Avoid planting strawberries on newly plowed sod until white grubs in the soil have been controlled. White grubs are very destructive to

strawberry plants. There are three methods of control. Where white grubs are a minor problem, plow the soil in the fall so that winter cold will control them. Where white grubs are a serious problem on freshly plowed land, plant the field to cultivate crops for a least two seasons. If the field needs to be planted immediately after plowing, apply metham (Vapam) at the rate of 50 to 100 gallons per acre active ingredient (47 to 94L/ha) 3 weeks before planting. This will give effective control.

It is generally not advisable to plant strawberries in a field where persistent weeds—like quack-grass, purslane, and chickweed—are abundant. In eastern Virginia, in parts of Tennessee, and in Arkansas the strawberry dwarf disease, caused by a bud nematode, is a serious threat. Avoid planting in infested soil for at least 2 years.

Preplanting soil fumigation with a broad spectrum fumigant like methyl bromide combines nematode and weed seed control. Including chloropicrin in the fumigant also controls some damaging soil-inhabiting fungi.

For further information on the nematode problem, see USDA Farmers' Bulletin 2140, "Strawberry Diseases." It is for sale from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Under most conditions, strawberries are grown on level ground. However, where the hill system is used, or if surface drainage is poor, they are grown on raised beds or ridges. A raised bed on which to set

the plants may be made by throwing two or more furrows together and leveling with a plank drag. Ordinarily the bed should be 2 or 3 inches (5 cm to 8 cm) high; it may be higher if drainage is very poor. There are machines designed to prepare and maintain raised beds. Intensive culture on raised beds has resulted in marked increases in yields, but raised beds must be protected against cold damage in the winter. Pulverize the soil thoroughly just before setting the strawberry plants. If the soil is plowed in the autumn, a thorough harrowing in the spring will be sufficient. However, the more thorough the land preparation, the better plant establishment and growth.

Planting Season

Temperature and moisture conditions for planting are usually best in early spring, and most strawberry planting is done then.

Late-set plants, unless they have been kept in cold storage, do not grow as well as early-set plants. Furthermore, the average yield from plants set in late summer will not be as large as from plants set in the spring.

Where the land must be fully utilized and rainfall is dependable, however, plants of those varieties that bud in late fall and early spring—such as Pocahontas and Albritton—are set in late summer to bear the following year. If plants are set at this time, plow a large quantity of strawy manure into the soil before planting. Later a fall mulch of strawy manure should be applied.

If the season is very dry or very wet, or if a winter mulch is not used, the plants set in the autumn will be killed by low winter temperatures. On very heavy soils, if early autumn planting is necessary, be sure to protect the plants by a mulch in winter. On such soils, it is preferable to plant in late spring with dormant cold-storage plants.

Plants for autumn setting must be large and should have good root systems. They must be set in moist soil. Irrigation is usually necessary for autumn-set plants to get a strong start.

Planting Methods

Whether plants are set by hand or by machine, it is important to—

- Keep the plants moist before setting.

- Set them at the correct depth.

- Make the soil firm around the plant roots.

For ease in planting, the ends of long roots may be cut back without harming the plants, but general root pruning is not recommended.

A trowel, dibble, or other suitable tool often is used to make holes for setting a small number of plants by hand (fig. 8).

Set the plants at correct depth, with the crown just below ground level (fig. 9). Plants set too deep are likely to smother and die. Plants set too shallow will dry out.

Pack the soil around the roots of the plants by stepping on each plant; place the instep over the crown of the plant and step firmly.

For more extensive plantings, the same sequence of operations is followed, but one person makes the

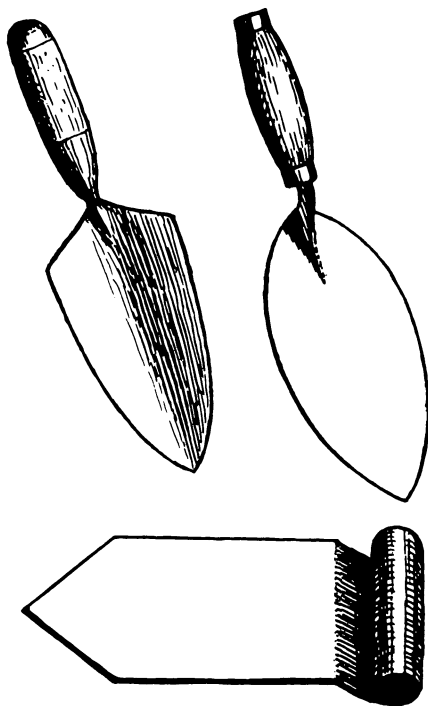


Figure 8.—Two types of trowels commonly used for planting strawberries. The type shown at top is best for most conditions.

holes, another drops the plants in them, and a third firms the soil around the plant roots.

Another common method of hand-setting strawberries requires two people. One person inserts a spade in the soil and forces it forward. While one person holds the spade in position, the other places a plant in the hole. The first person then withdraws the spade and firms the soil around the plant roots with a foot.

When setting plants by hand, protect them from drying by carrying them in a basket, bucket, or sack.

Planting machines are used for setting strawberries when planting 2 acres (0.8 ha) or more. A skilled crew can machine set 3 to 5 acres (1 to 2 ha) a day.



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Figure 9.—Plants set at different depths: A, plant set too deep; B, plant set at correct depth; C, plant set too shallow.

Care of the Planting

Cultivating

Use the cultivator as often as once a week during the first season to control weeds. Hoe as often as necessary to clean out weeds between the plants.

Hoe and cultivate toward the plants. This keeps the roots from being killed by exposure to the air. Keep the crowns of the plants at ground level at all times. Set the teeth on each side of the cultivator so they will not stir the soil more than 1 or 2 inches (2.5 to 5 cm) deep near the rows. This prevents loosening the plants or cutting their roots.

It is not possible to cultivate a field after it is mulched in the fall; so, if you are going to use mulch, continue to cultivate until you apply it.

Ordinarily, no cultivating is done in the spring of the fruiting year. If the field chosen for the planting is not heavily infested with weeds, and if recommendations for cultivation, chemical weed control, and mulching are followed the first year, weeds, should not be a serious problem before the crop is picked.

If the planting is renewed, cultivate and hoe as you would for a newly set field.

Removing Flowers

Culture of newly set strawberry plants should aim for vigorous growth rather than flowering or bearing. During the first season, remove flower stems on the plants as soon as they appear (fig. 10). This strengthens the plant and also increases the number of runner plants. This is an advantage because early-



Figure 10.—Removing flowers the first season helps the plant to make vigorous vegetative growth.

formed runner plants bear the most fruit the following year.

Thinning and Spacing

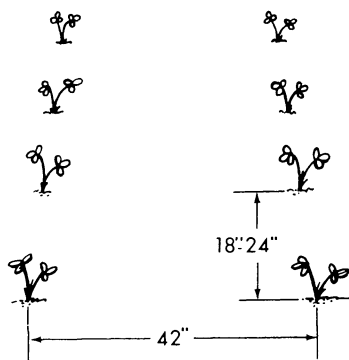
HILL SYSTEM.—Under the hill system, whenever runner plants appear throughout the first summer, cut them off. Use a hoe or a cutter made for the purpose. If the soil is free from stones and straw, cut the runners with two rolling colters attached to the cultivator, set to run between the rows.

SPACED MATTED-ROW SYSTEM.—Under the spaced matted-row system, train the runners by hand so that runner plants are 6 to 8 inches (15 to 20 cm) apart (fig. 11). Establish plants in the desired position by covering the tips of the runners with soil as soon as they begin to enlarge. The plant bed should be 18 to 24 inches (46 to 61 cm) wide, with about 24 inches (61

cm) of alley between rows. This spacing is retained in thinning.

MATTED-ROW SYSTEM.—Under the matted-row system, allow all runners to root until early fall. The beds formed usually have 2 to 3 inches (5 to 8 cm) between plants. Keep the beds 18 to 24 inches (46 to 61 cm) wide, with alleys about 24 inches (61 cm) wide between the rows. Use rolling colters on a culti-

ORIGINAL PLANTING



FINAL STAND

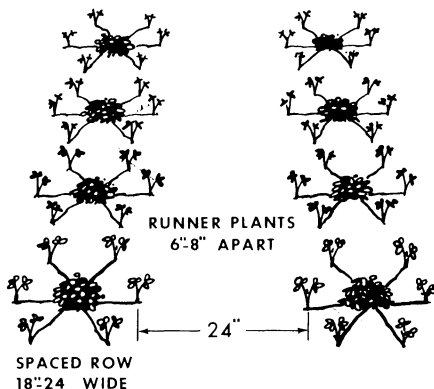


Figure 11.—In the spaced matted-row system, plants are set 18 to 24 inches (46 to 61 cm) apart in rows 42 inches (107 cm) apart (top). The runner plants that are allowed to develop are placed in desired positions; in the final stand, plants are 6 to 8 inches (15 to 20 cm) apart in rows 18 to 24 inches (46 to 61 cm) wide.

vator set to cut all runners that extend into the alleys after the desired stand of plants has been obtained.

During late summer or autumn, thin the plants to 3 or 4 inches (8 to 10 cm) between each plant. Remove surplus runners when you hoe the planting. You may run a spike-toothed harrow—with teeth set to slant backward—across the rows to thin them; but be careful not to loosen too many plants with the harrow.

Mulching

Mulching protects the planting against plant losses caused by low temperatures and by soil heaving that may result from freezing and thawing.

Mulching also helps to keep down weeds, to keep the berries clean, and to conserve moisture.

Small-grain straws and marsh hay are the best mulching materials. Other satisfactory materials are pine needles, ferns, strawy stable

manure, hay, Sudan grass, mixtures of kafir and sorghum fodders, and mixtures of spring oats, straw, and sorghum fodders. If Sudan grass, kafir, or sorghum is used, it should first be run through a hay crusher. Crushing allows the material to dry rapidly and therefore reduces the risk of moldy or rotten mulch.

Treating bales of straw with heat or chemical sterilants will kill grain or weed seed lodged in the bales and prevent its germination.

Mechanical application of mulch saves time and labor (fig. 12).

Fertilizing

Strawberry plants that are growing vigorously and have dark-green leaves throughout the summer probably have an adequate supply of fertilizer.

However, strawberries benefit from 30 pounds per acre (34 kg/ha) of active nitrogen applied 2 to 4 weeks after plants are established (either in a complete fertilizer or a



Figure 12.—Applying mulch by machine.

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nitrogen carrier alone) and 30 to 60 pounds of nitrogen per acre (34 to 68 kg/ha) about one month before flower buds are formed in the fall. Soil or leaf analyses will help determine the exact amounts of fertilizers needed.

Applying fertilizer to the fruiting crop is not normally recommended; it is best to apply it the year the plants are set. If the planting is renewed, fertilizer should be applied during the renewal operation.

Liming

Liming the soil provides calcium and, if the lime is in the form of dolomite, magnesium as well. Liming also decreases soil acidity.

Strawberries grow well in soil that has an acidity (pH) range of 5.7 to 6.5. They may grow well in soil of pH 5.0 to 7.0 (neutral acidity) if the soil is high in organic matter. Soil that tests pH 5.3 or less should be limed.

Have your soil tested to determine how much lime is needed. Do not apply more than is recommended; too much lime reduces the size of the plants and fruit.

Lime should be applied to previous crops. If it is not possible to apply lime a year or two before planting strawberries, apply it and work it into the soil thoroughly before the strawberry plants are set.

Irrigating

Irrigating strawberry plantings is especially beneficial if there is dry weather either in the summer when the plants are getting established,

or in the spring from blossomtime through the fruiting season, and in the late summer and early fall when flower buds are forming.

Sprinkler or surface irrigating systems may be used on strawberry plantings. Pesticides and soluble fertilizers may also be applied through the irrigation system during the growing season.

The most common sprinkler irrigation systems consist of 4-inch (10-cm) portable aluminum pipes with 3-inch (8 cm) pipes attached to them laterally. The rotating sprinkler heads are mounted at 40-foot (1.2-m) intervals on the lateral pipes. About 1,100 feet (330 m) of lateral 3-inch (8 cm) pipe is needed per acre.

For commercial plantings of $\frac{1}{4}$ acre ($\frac{1}{10}$ ha) or less, or for home gardens, use an eyelet hose sprinkler system. This is a flat plastic tube having small holes spaced along its upper side. With suitable pressure, an eyelet hose will irrigate 3 or 4 rows at a time.

Furrow irrigation, a form of surface application, is used where the land has sufficient slope to let the water flow slowly down the furrows.

The soil must be of a fairly heavy texture so that the irrigation water will flow the full length of the furrows, which should not be more than 200 to 250 feet (60 to 75 m) long.

For sandy soils with a gentle slope, a porous canvas hose may be useful. However, only one or two rows can be irrigated at one setting of the hose.

Drip (trickle) irrigation can also be used successfully in strawberry culture.

Protecting Against Winterkill

In the autumn the strawberry plants gradually become hardier and by winter they can stand normal winter temperatures. However, if a sudden cold snap with temperatures lower than about 20° F (−7° C) occurs before the plants harden, they may be severely damaged. Temperatures of 15° F (−10° C) or lower may kill unhardened plants.

Plants may also be killed if alternate freezing and thawing of soil heaves the plants out of the ground or breaks their roots.

Mulching protects strawberry plantings against low temperatures and against rapid alternate freezing and thawing.

Ordinarily, as soon as a temperature of 20° F (−7° C) or lower has occurred, the strawberry plants will have become hardened, and the mulch should be applied. Recommended mulching dates are shown in figure 13.

In the upper Mississippi Valley area, about 6 tons (15 t/ha) of mulch per acre are required; elsewhere, 2 to 2½ tons (5 t/ha) are sufficient.

Rake all but a light covering of mulch into the alleys between the rows as soon as the plants begin to grow in the spring.

Protecting Against Spring Frosts

Strawberry plants may need to be protected against frost damage

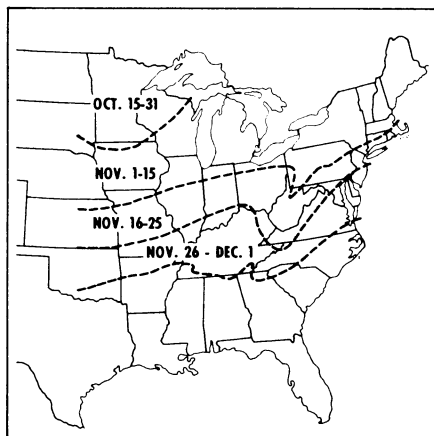


Figure 13.—The best mulching dates for the areas outlined by broken lines usually are in the range of dates shown for the areas. Dates are not given for some of the southernmost areas to which this bulletin applies because winter temperatures normally are not low enough to hurt plants.

while they are flowering. This protection is usually provided in one of three ways:

- Using mulch.
- Operating sprinkler irrigation system.
- Using heaters.

If the field has been mulched, and the mulch removed from the rows to the alleys, simply rake it back over the plants again if a freeze is expected. Be sure to uncover the plants the following morning.

If a sprinkler irrigation system is available, it can be used to protect plants against temperatures as low as 19° F (−7° C). Get the system in position and test it if such an operation is anticipated. For extensive plantings or intensive culture, it is wise to have a “backup” or extra pump in the event of failure of the initial pump. Begin sprinkling as soon as the temperature at the plant level drops to 32° F (0° C).

Continue until higher temperatures return and all ice has been melted off the plants by the irrigation water.

Use small nozzle tips on the sprinkler heads to avoid getting too much water on the soil. Space the heads at 60 by 80 feet (18 by 24 m), or 80 by 80 feet (24 by 24 m) if sufficient water pressure is available. Use sprinkler heads that rotate one revolution per 12 to 20 seconds.

Heating the planting is another frost protection method but is less effective than sprinkler irrigation. If heaters are used, 100 per acre (240/ha) will be needed when the temperature drops to 26° F (−3 C) at the level of the plants.

Insects and Diseases

Growers should familiarize themselves with insect and disease enemies of strawberries that are likely to occur in their localities, and thus be able to recognize and combat them as soon as they are discovered.

Growers should keep in close touch with the experiment stations in their own States, and upon discovering unfamiliar insects, should send specimens to the stations or to the U.S. Department of Agriculture for examination. Early recognition of an insect in a locality may make it possible to apply control measures that will prevent a serious outbreak.

Information on disease control is given in USDA Farmers' Bulletin 2140, "Strawberry Diseases."

Chemical Weed Control

Herbicides control weeds effectively and economically. Good results, however, depend on using herbicides correctly—

- Do not use them on fields grown primarily for planting-stock production.

- Do not use more than one of them unless instructions specify that more are recommended.

- Test them on a small area before using them on a large scale.

- Make treatments when conditions are best for plant growth and weed seed germination.

- Apply them only when strawberry plants are in vigorous condition.

- Apply them at rates recommended by the manufacturers as stated on the label.

Rates of application in the following recommendations are for herbicides only—use the quantity of water recommended by the manufacturer. Usually the required amount of water will be 10 to 40 gallons per acre (77 to 360 L/ha).

Late Spring and Summer Weeds

Several herbicides are safe and effective for controlling late spring and summer weeds in strawberry plantings. They are applied to the soil to kill the germinating weed seeds. Choose your herbicide according to your weed problem. For assistance in identifying weeds, see Agriculture Handbook 366, "Selected Weeds of the United States."

Use the following herbicides as needed:

- Chloroxuron (Tenoran)² at 4

² Trade names are used in this publication solely to provide specific information. Mention of a trade name does not constitute a guarantee of the product by the U.S. Department of Agriculture nor does it imply an endorsement by the Department over comparable products that are not named.

pounds per acre active ingredient (a.i.) to established plantings or to transplants which have become established. Certain varieties such as Tennessee Beauty may be sensitive to Tenoran.

- DCPA (Dacthal), at 9 pounds per acre (10 kg/ha) a.i. before or at transplanting or at 6 to 9 pounds per acre (7 to 10 kg/ha) in the fall and early spring to established plantings.

- Diphenamid (Enide or Dymid), at 4 to 6 pounds per acre (4 to 7 kg/ha) a.i. 2 to 6 weeks after transplanting or to established plantings when dormant or after harvest. Diphenamid may reduce daughter plant rooting in some instances.

The most common weeds controlled by these herbicides are crab-

grass, lovegrass, goosegrass, pigweed, lambsquarters, purslane, and carpetweed. Specific weeds controlled by each herbicide are listed on the manufacturer's label.

All herbicides should be used cautiously on new strawberry varieties until experience has shown that the varieties are tolerant of the herbicide under local climatic conditions and cultural practices. Because herbicide performance is affected by these local factors, follow directions on the labels carefully.

Winter and Early Spring Weeds

Chickweed, henbit, and annual bluegrass germinate in the cool weather of fall and early spring. They can be controlled by applying



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Figure 14.—Sesone prevented germination of weed seeds in the plot at right. Crabgrass, goosegrass, foxtail, lambsquarters, pigweed, and other weeds infested the untreated plot at left. Neither plot was cultivated after runner production started.

DCPA at 6 to 9 pounds per acre (7 to 10 kg/ha) a.i. when the weeds are beginning to germinate.

Newer herbicides for this period are Terbacil (Sinbar) at $\frac{3}{4}$ pounds per acre ($\frac{7}{8}$ kg/ha) a.i. and Napropamide (Devrinol) at 4 pounds per acre (4 kg/ha) a.i. The safety margin is lower with these newer herbicides so that applied concentrations must be accurate. The variety, Guardian, appears sensitive to Sinbar under certain conditions.

If a straw mulch is used, the herbicide should be applied before mulching to kill the weeds and germinating small grain. A single herbicide treatment will usually control winter and early spring weeds when mulch is used.

Renewing the Planting

The root system is often weakened while the fruit crop is maturing, and by the end of the fruiting season the root system may be incapable of properly supporting the top growth. In some plantations the vigor of the plants can be restored by removing the tops, fertilizing, cultivating, and eliminating weeds. These operations are called renewing or rejuvenating the planting.

Renewing as an alternative to replanting may or may not be profitable; it depends on such things as the variety being grown; weed, insect, and disease infestation; and the character of the soil.

Plantings of varieties that produce their largest crops the first year after setting may not be worth renewing—it is usually more profitable to plow up the fields and set new plants. Renewing often pays

on planting of varieties that yield bigger crops the second and third year after setting than the first year.

If you decide to retain the (planting) renew it—do not permit the harvested plants to continue growing without mowing the tops, cultivation and thinning.

Some varieties—Pocahontas, Redchief, and Guardian are examples—yield large crops for a number of years, and it may be more profitable to maintain such plantings for several years than to plow them up and start a new planting.

Regardless of the variety grown, it may be necessary to plow up the field after the first year if there is a heavy infestation of weeds that are difficult to control—weeds such as white clover, purslane, perennial grasses, and crabgrass. Serious disease and insect infestations may be other good reasons for starting a new field or planting a rotation crop instead of renewing.

Ordinarily, the cost of renewing a planting is less than the cost of establishing a new field.

Cutting the Tops

Cutting off the tops of plants is the first step in renewing a planting (fig. 15). Fields of plants trained to the matted-row system usually are mowed by machine; fields of plants trained to the hill system usually are cut off with a scythe, sickle, or hoe. Do not cut low enough to injure new leaves just emerging from the crown.

In the North, where the growing season is short, mow the foliage as soon as the crop has been picked.



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Figure 15.—Tops of the plants at right have been mowed; other renewal operations, such as thinning and turning under mulch, will follow.

Where the growing season is longer, the mowing may be delayed for 2 weeks.

Turning Under

If injury from insects and disease is not serious, turn under the mulch and leaves. This will increase the amount of organic matter in the soil and put it in good tilth. When the mulch is very heavy, remove part of it before turning under. If it is not too much decayed, this mulch may be stacked for future use. If insects and foliage diseases are prevalent, spray with appropriate compounds for control before turning under, in-

cluding the rows from which the tops have been removed.

Thinning the Plants

If you grow plants in matted rows, you probably should thin them when the planting is renewed. Omit thinning only if you grow varieties that produce very few runner plants. No thinning is needed with the hill system or the spaced-row system.

Plants in matted rows should be thinned 6 to 8 inches apart after renewing. Most of the excess plants can be removed by running a spike-

toothed harrow once or twice across the rows and then once down the rows. This tears up the weaker plants and levels the ridges made by plowing up the rows. Further thinning—if required—may be done with a hoe.

The crowns of the thinned plants are usually covered with up to an inch or two of soil. Within 2 or 3 weeks, the plants will grow new foliage.

Use of Pesticides

Pesticide use is governed by a Federal law administered by the Environmental Protection Agency (EPA). This law requires manufacturers to register pesticides, and

makes it illegal for people to use them except in accordance with the instructions on the label.

Follow label instructions carefully. You may, if you wish, use less of a pesticide than the amount permitted. Apply pesticides uniformly and be sure they come in contact *only* with plants or areas you intend to treat.

Registrations of pesticides are under constant review by EPA. As new information is developed and evaluated, registrations may be changed or withdrawn. For the latest information on pesticides and how to use them, consult your local Extension agent or the Cooperative Extension Service or Agricultural Experiment Station in your State.



Use Pesticides Safely
FOLLOW THE LABEL
U.S. DEPARTMENT OF AGRICULTURE

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